CLAIMS

1 Electron focussing apparatus comprising:

cathode means defining an impact surface on which particles impact, which surface has a finite probability of generating at least one electron for each impacting particle having predetermined characteristics;

an electron receiving element; and

respective means for generating electrostatic and magnetic fields in a space extending from said impact surface to said electron receiving element;

wherein said means for generating said electrostatic and magnetic fields are configured whereby the E/B^2 ratio adjacent said electron receiving element is smaller than adjacent the impact surface, whereby to decrease the radius of curvature of the electron trajectories adjacent said electron receiving element relative to adjacent the impact surface and to thereby focus the electron trajectories in at least one dimension.

2 Electron focussing apparatus according to claim 1 wherein said E/B^2 ratio is progressively decreased from the impact surface to said electron receiving element.

3 Electron focussing apparatus according to claim 1 wherein said electron receiving element extends in a direction behind said impact surface relative to the trajectories of said particles, in a plane disposed laterally of an adjacent edge of said impact surface.

4 Electron focussing apparatus according to claim 3 wherein said electron receiving element is in a plane substantially at 90° to said impact surface.

5 Electron focussing apparatus according to claim 1 wherein said magnetic field is configured to also focus the electron trajectories in a direction generally orthogonal to the overall direction of the trajectories.

6 Electron focussing apparatus according to claim 1 wherein said electron receiving element is positioned and said means for generating said electrostatic and magnetic fields are configured to cause said electrons to deflect on average through greater than 180° before impacting the electron receiving element, whereby to focus, in at least one dimension, multiple electrons generated from any given area of said impact surface to a smaller area at said electron receiving element.

7 Electron focussing apparatus according to claim 6, wherein, for optimal time coherence, the average deflection is through substantially a multiple of 90°.

8 Electron focussing apparatus according to claim 7 wherein the average deflection is through substantially 270°.

9 Electron focussing apparatus according to claim 1 wherein said electron receiving element is a dynode segment.

10 Electron focussing apparatus according to claim 1 wherein the electron trajectories are focussed in at least two dimensions.

11 A particle detector employing electron multiplication, comprising:

cathode means defining an impact surface on which particles impact, which surface has a finite probability of generating at least one electron for each impacting particle having predetermined characteristics;

a plurality of electron multiplication dynode segments, including a first dynode segment, arranged in an array; and

respective means for generating electrostatic and magnetic fields in a space extending from said impact surface past said dynode segments, whereby said electrons cascade and multiply successively along said array of dynode segments;

wherein said means for generating said magnetic and electrostatic fields are configured whereby the E/B^2 ratio adjacent any of said dynode segments is smaller than adjacent the preceding dynode segment or impact surface relative to the direction of the cascade, whereby to decrease the radius of curvature of the electron trajectories along said cascade and to thereby focus the electron trajectories in at least one dimension.

12 A particle detector according to claim 11, wherein said E/B^2 ratio is

progressively decreased from the first dynode segment or impact surface to the next dynode.

13 A particle detector according to claim 11 wherein said E/B^2 ratio decreases in the region from the impact surface to the first dynode segment.

14 A particle detector according to claim 11 wherein there is a progressive decrease in the E/B^2 ratio along the dynode array.

15 A particle detector according to claim 11 wherein said dynode array extends in a direction behind said impact surface relative to the trajectories of said particles, in a plane disposed laterally of an adjacent edge of said impact surface.

16 A particle detector according to claim 15 wherein said dynode array is in a plane substantially at 90° to said impact surface.

17 A particle detector according to claim 11 wherein said magnetic field is configured to also focus the electron trajectories in a direction generally orthogonal to the overall direction of the trajectories.

18 A particle detector according to claim 11 wherein said first dynode segment is positioned and said means for generating said electrostatic and magnetic fields are configured to cause said electrons to deflect on average through greater than 180° before impacting said first dynode segment, whereby to focus, in at least one dimension, multiple electrons generated from any given area of said impact surface to a smaller area at said first dynode segment.

19 A particle detector according to claim 18, wherein, for optimal time coherence, the average deflection is through substantially a multiple of 90°.

20 A particle detector according to claim 19 wherein the average deflection is through substantially 270°.

21 A particle detector according to claim 11, wherein said dynode segments are discrete.

22 A particle detector according to claim 11, wherein said dynode segments are segments of a continuous dynode formed, for example, from resistive secondary electron emissive material.

23 A particle detector according to claim 11, wherein the electron trajectories are focussed in at least two dimensions.

24 Electron focussing apparatus comprising:

cathode means defining an impact surface on which particles impact, which surface has a finite probability of generating at least one electron for each impacting particle having predetermined characteristics; and

an electron receiving element;

respective means for generating electrostatic and magnetic fields in a space extending from said impact surface to said electron receiving element;

wherein said electron receiving element is positioned and said means for generating said electrostatic and magnetic fields are configured to cause said electrons to deflect on average through greater than 180° before impacting the electron receiving element, whereby to focus, in at least one dimension, multiple electrons generated from any given area of said impact surface to a smaller area at said electron receiving element.

25 Electron focussing apparatus according to claim 24, wherein, for optimal time coherence, the average deflection is through substantially a multiple of 90°.

26 Electron focussing apparatus according to claim 25 wherein the average deflection is through substantially 270°.

27 Electron focussing apparatus according to claim 24 wherein said electron receiving element is a dynode segment.

28 A particle detector employing electron multiplication, comprising:

cathode means defining an impact surface on which particles impact, which surface has a finite probability of generating at least one electron for each impacting particle having predetermined characteristics;

a plurality of electron multiplication dynode segments, including a first dynode segment, arranged in an array; and

respective means for generating electrostatic and magnetic fields in a space extending from said impact surface past said dynode

segments, whereby said electrons cascade and multiply successively along said array of dynode segments;

wherein said first dynode segment is positioned and said means for generating said electrostatic and magnetic fields are configured to cause said electrons to deflect on average through greater than 180° before impacting the first dynode segment, whereby to focus, in at least one dimension, multiple electrons generated from any given area of said impact surface to a smaller area at said first dynode segment.

29 A particle detector according to claim 28, wherein, for optimal time coherence, the average deflection is through substantially a multiple of 90°.

30 A particle detector according to claim 29 wherein the average deflection is through substantially 270°.

31 A particle detector according to claim 28 wherein said dynode array is substantially coplanar.

32 A particle detector according to claim 31, wherein the detection is through substantially 270°, and the direction of particle incidence on the impact surface is substantially parallel to the plane of the dynode array.

33 A particle detector according to claim 28, wherein said dynode segments are discrete.

34 A particle detector according to claim 28, wherein said dynode segments

are segments of a continuous dynode formed, for example, from resistive secondary electron emissive material.

35 A particle detector according to claim 28 wherein said magnetic field is configured to also focus the electron trajectories in a direction generally orthogonal to the overall direction of the trajectories.

36 Electron focussing apparatus comprising:

cathode means defining an impact surface on which particles impact, which surface has a finite probability of generating at least one electron for each impacting particle having predetermined characteristics; and

an electron receiving element;

respective means for generating electrostatic and magnetic fields in a space extending from said impact surface to said electron receiving element;

wherein said means for generating a magnetic field comprises at least two magnetic poles positioned with respect to said cathode means to generate a magnetic field extending in a direction generally orthogonal or nearly orthogonal to said electrostatic field but configured to cause focussing, in said direction, of trajectories of said electrons from said impact surface to said electron receiving element.

37 Electron focussing apparatus according to claim 36 wherein said electron receiving element extends in a direction behind said impact surface relative to the trajectories of said particles, in a plane disposed laterally of an

adjacent edge of said impact surface.

38 Electron focussing apparatus according to claim 37 wherein said electron receiving element is in a plane substantially at 90° to said impact surface.

39 Electron focussing apparatus according to claim 36 wherein said electron receiving element is a dynode segment.

40 A particle detector employing electron multiplication, comprising:

cathode means defining an impact surface on which particles impact, which surface has a finite probability of generating at least one electron for each impacting particle having predetermined characteristics;

a plurality of electron multiplication dynode segments, including a first dynode segment, arranged in an array; and

respective means for generating electrostatic and magnetic fields in a space extending from said impact surface past said dynode segments, whereby said electrons cascade and multiply successively along said array of dynode segments;

wherein said means for generating a magnetic field comprises at least two magnetic poles positioned with respect to said cathode means to generate a magnetic field extending in a direction generally orthogonal or nearly orthogonal to said electrostatic field and configured to cause focussing, in said direction, of trajectories of said electrons from said impact surface to said first dynode segment.

41 A particle detector according to claim 40 wherein said dynode array extends in a direction behind said impact surface relative to the trajectories of said particles, in a plane disposed laterally of an adjacent edge of said impact surface.

42 Electron focussing apparatus according to claim 41 wherein said dynode array is in a plane substantially at 90° to said impact surface.

43 A particle detector according to claim 40 wherein said dynode segments are discrete.

44 A particle detector according to claim 40 wherein said dynode segments are segments of a continuous dynode formed, for example, from resistive secondary electron emissive material.

45 An electron multiplier comprising a particle detector according to claim 11.

46 An electron multiplier according to claim 45, wherein the impact surface itself is a dynode for generating electrons in response to impacting electrons.

47 An electron multiplier according to claim 45, wherein the impact surface is associated with an entrance grid.

48 An electron multiplier comprising a particle detector according to claim 28.

49 An electron multiplier according to claim 48, wherein the impact surface itself is a dynode for generating electrons in response to impacting electrons.

50 An electron multiplier according to claim 48, wherein the impact surface is associated with an entrance grid.

51 An electron multiplier comprising a particle detector according to claim 40.

52 An electron multiplier according to claim 51, wherein the impact surface itself is a dynode for generating electrons in response to impacting electrons.

53 An electron multiplier according to claim 51, wherein the impact surface is associated with an entrance grid.